

Remarks

Claims 1-11, 16, 17, 19, 21-32, 34-37, 44-53, 55-76 and 85-88 are pending.

Claims 19, 21, 22, 25-27, 29-32, 36 and 51-53 have been withdrawn from consideration.

Claims 44 and 48-53 have been amended merely to clarify language used in the claims and/or the subject matter claimed. The scope of the claims is intended to be the same as before the amendment. No new matter has been added.

The Examiner's indication of the allowability of Claims 16 and 28 upon amendment is acknowledged.

Election/Restrictions

The Examiner indicated that the application contains claims 19, 21-22, 25-27, 29-32, 36, 51-53 drawn to an invention nonelected with traverse in the reply filed on 10/06/2005.

Applicant notes that the restriction was for an election of species and that Applicant will be entitled to consideration of claims to additional species upon allowance of a generic claim. Therefore, the withdrawn claims are hereby maintained.

Objection to Claims

The Examiner objected to Claim 48.

Claim 48 has been amended to change the term "die" to dies" in lines 2-3 and 9. Accordingly, withdrawal of this objection is respectfully requested.

Rejection of Claims under 35 U.S.C. §§ 102(e)/103(a) (MacDonald)

The Examiner rejected the claims as follows:

- a) Claims 1-8, 17, 24, 34-35, 37, 44, 48, 62-63 and 85-88 as obvious over MacDonald (USP 5,199,917) in view of Hofstee (USP 6,541,847). This rejection is respectfully traversed.
- b) Claims 9, 45, 46-47, 49-50, 55-57 and 64-76 as obvious over MacDonald in view of Hofstee, and further in view of McMillan (USP 5,650,593).

- c) Claims 10 and 11 as obvious over MacDonald in view of Hofstee, and further in view of Admitted Prior Art (APA), Figures 1-2 and the specification at pages 1-2.
- d) Claims 23 and 60 as obvious over MacDonald in view of Hofstee, in view of Gregory (USP 4,710,419).

Applicant reserves the right to swear behind Hofstee, which was filed February 4, 2002 (versus Applicant's filing date of February 15, 2002) and makes no admission regarding Hofstee as prior art to Applicant's invention.

The Examiner cites MacDonald as the primary reference for disclosing Applicant's devices and methods pointing to element **152** as a "die" and element **92** in Fig. 3 as the stiffener component, except for the "stiffener" being made of molded plastic material, citing to Hofstee, as follows (Office Action at pages 3-4; emphasis added).

Regarding claims 1, 24, 34, 85-88, MacDonald discloses a semiconductor device having a substrate 10 (fig. 3) having...a periphery with *a die 152* (Fig. 3)...and a plurality (support structures) *stiffener components 92* (fig. 3)...

However, MacDonald does not explicitly teach that the stiffeners are made of molded plastic material.

Hofstee discloses an analogous device having a substrate 120 (122, 123, 124) (fig. 4); and a plurality molded plastic stiffener components 125, 126 (fig.4, col. 5, lines 30-35)...

The Examiner maintains that it would have been obvious to modify the "stiffeners" of MacDonald with the molded plastic material taught by Hofstee, on the basis of its suitability for the intended use. The Examiner cites McMillan as disclosing a thermoplastic material, the APA as disclosing molded stiffeners composed of thermoplastic or thermosetting polymer material, and Gregory for disclosing a substrate 30 in a form of a reel (Figs. 2-7).

Regarding the device claims, the Examiner proposes that it would be obvious to replace the oxide pillar supports **92** in MacDonald with a plastic material from Hofstee (and McMillan and APA). Regarding the method claims, the Examiner maintains that it would be obvious to modify MacDonald's method to mold a plastic material onto substrate 120 (Fig. 4) to form a plurality of stiffeners 125, 126 as disclosed by Hofstee.

MacDonald discloses a silicon fabrication technique in which an array of conically shaped electron emitter tips are formed by an oxidation process to ensure accurate and

precise formation, and an oxidation step to precisely align holes in the overlying gate electrode with respect to the emitter tips.

First of all, the Examiner cites to component **152** (Fig. 3) as a 'die'. This is incorrect. Components **152**, **154** are portions of a gate electrode *metal* layer **80** – not a die as required by Claims 34, 48-53, 56, 57 and 73-76.

The Examiner cites to component **92** in Fig. 3 of MacDonald as a "stiffener component." Component **92** is an oxide support structure beneath a *gate electrode* metal layer **80**. See **Fig. 3** and corresponding **Fig. 1h**.

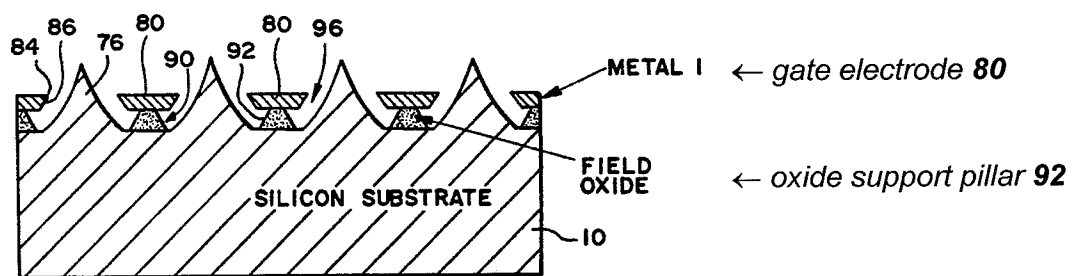


FIG. 1h

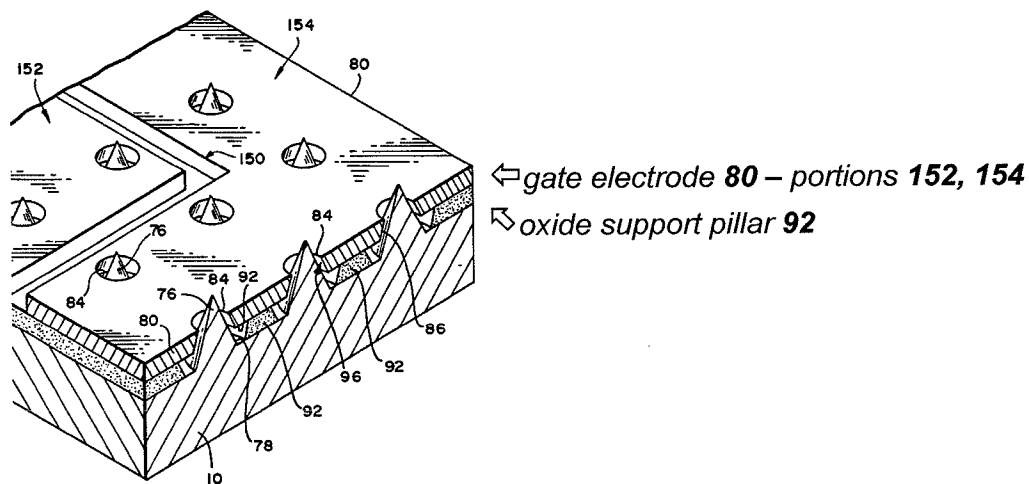


FIG. 3

One skilled in the art reading MacDonald would not alter that structure to replace the oxide support pillars **92** with a plastic material as proposed by the Examiner.

MacDonald is directed to the problem of providing a precise formation of emitter tips 76 and to precisely align holes in the overlying gate electrode 80 with respect to the emitter tips.

As the solution to that problem, MacDonald teaches a silicon fabrication process that uses oxidation steps to form the emitter tips 76 and the support pillars 92. See, for example, at col. 2, lines 53-64 (emphasis added).

The foregoing objects are attained, in accordance with the present invention, through a silicon fabrication process in which an emitter tip array is produced by electron beam or other suitable submicrometer scale lithography for precise location of the emitters, and *in which the emitter tips are formed by an oxidation process which ensures accurate and precise formation of tips having uniform radii. The process also utilizes the oxidation step to precisely align gate electrode apertures with respect to corresponding emitter tips so that large arrays can be formed with great accuracy and reliability.*

MacDonald teaches a precise process flow that requires forming an oxide layer 70 on a silicon substrate 10, forming a metal layer 80 on the oxide layer 70, and then removing portions of oxide layer 70 to undercut and form the oxide support pillars 92 underneath the metal layer 80. This is illustrated in Figs. 1e through Fig. 1h, and described as follows (emphasis added).

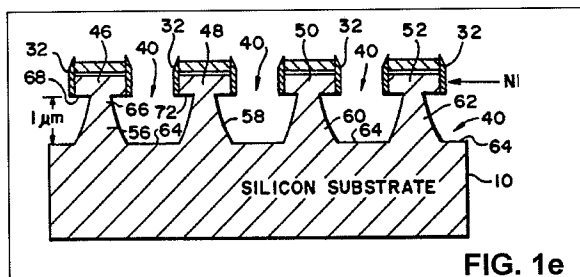


FIG. 1e

At col. 6, lines 61-64:

The exposed surface 30 of the silicon substrate 10 is further etched ...thereby forming recesses such as those illustrated at 40 in FIG. 1e....

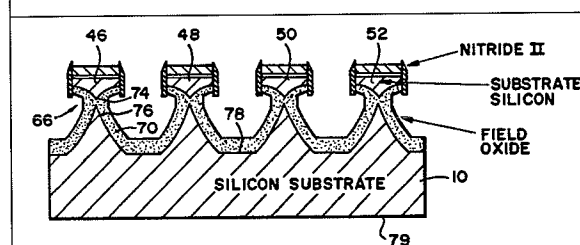


FIG. 1f

At col. 7, lines 12-33:

The structure of FIG. 1e is then oxidized...to form a layer of oxide 70, illustrated in FIG. 1f, on the exposed surfaces of the silicon material 10. The thickness of layer 70 is sufficient to oxidize all of the silicon in the region of the neck portion 66 of the pillars which support the silicon islands ...thereby separating the islands 46, 48, 50 and 52 from their corresponding supporting silicon pillars 56, 58, 60 and 62, and electrically isolating the islands from the underlying silicon substrate 10, as illustrated in FIG. 1f. ...

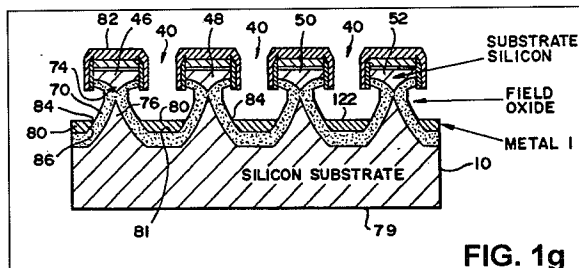


FIG. 1g

At cols. 7-8, bridging paragraph:

As illustrated in **FIG. 1g**, a gate electrode metal layer **80**, identified as "Metal I", is deposited on the upper surfaces of the wafer as by line-of-sight evaporation to form a layer ...on the horizontal bottom surfaces **81** of apertures **40** surrounding the islands. ...Because of the presence of the oxide layer 70 on the surfaces of the upwardly-facing lower tips **76**...the metal layer **80** forms circular apertures around the conical tips **76** with the interior edges **86** of these apertures being spaced from the conical tips **76** by the thickness of the oxide layer. ...

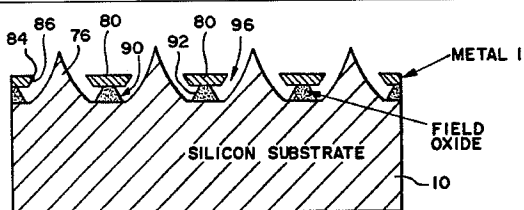


FIG. 1h

At col. 8, lines 26-47:

...the next step in the process is the removal of the islands **46, 48**, etc. and the dielectric and metal caps which the islands support. The caps are lifted off by etching the wafer in a buffered hydrofluoric acid solution to remove the oxide layer **70** around the conical tips **76**, as illustrated in **FIG. 1h**. *The etching process is continued until the oxide layer 70 is removed from the side walls of the conical tips 76 to expose the tips, and until the metal layer 80 is undercut ...This undercutting leaves an oxide support structure 92 beneath the gate electrode layer 80 to secure layer 80 to the floor 78 of the silicon substrate 10 and to hold it in position with respect to the tips 76.*

...This support structure **92** ensures that the apertures **84** remain accurately aligned with their corresponding tips. ...

See also at cols. 2-3, bridging paragraph, in which MacDonald stresses the importance of the use of a silicon substrate to form the silicon emitter tips, and the oxidation step and oxide layer to form uniform silicon tips throughout the array and the oxide support pillars between adjacent tips and beneath the gate metal layer to hold it securely in place (emphasis added).

In accordance with the present invention, an electron emitter source consisting of at least one, and preferably an array of emitter tips surrounded by a closely-spaced and accurately aligned electrode is provided, whereby accurate control of electron emission can be obtained. The tips and their aligned electrodes are produced by a fabrication process wherein a *plurality of silicon islands surrounded by channels or trenches are formed in a silicon substrate*, with the islands being supported by corresponding vertical tapered silicon pedestals which extend upwardly from, and are integral with, the substrate. ...The oxidation step also provides a *uniform layer of oxide on the pedestals, or lower tips, and on the horizontal surface of the substrate between the tips. The silicon tips formed by this oxidation step are the emitter tips for the array, and the shape of the tip is a critical factor in providing a uniform emission from the emitter array.* Since the oxidation of the

pedestals advances uniformly from all sides of the pedestal, the silicon material "shrinks" uniformly. ...The oxidation process is uniform throughout the array so that all of the emitters will be the same size with the same tip diameter. Thereafter, a layer of gate electrode metal is deposited on the horizontal oxide layer between the tips, *with the metal surrounding the individual tips and being spaced therefrom by the thickness of the oxide layer on the tips so that apertures are formed in the metal in exact alignment with the tips.* In addition, the metal is *spaced above the surface of the substrate by the oxide layer.* Thereafter, *the oxide layer is etched to lift off the islands and their included upper tips and further to remove the layer of oxide on the pedestals to thereby expose cone-shaped, tapered tips.* The oxide etching *step also removes a selected portion of the oxide from the substrate surface by undercutting the gate electrode metal adjacent the tips. This undercutting leaves oxide support pillars* between adjacent tips and beneath the gate metal to support the gate metal and hold it securely in place so that the apertures remain in alignment with respect to the tips.

The formation of the oxide layer **70** is essential to oxidize the silicon pillars and to space the metal layer **80** from the conical tips **76** – and then to form the support pillars **92** underneath the metal layer **80**.

The support pillars **92** are formed from the oxide layer **70** after the metal layer **80** has been formed. The proposed modification to replace the oxide support pillars **92** with a plastic molded material would not work in MacDonald's process flow or structure.

Nor would a skilled art worker make such a modification – particularly in view of MacDonald's teaching of the need for the precise spacing of the silicon emitter tips within the apertures (holes) of the surrounding metal layer which is provided through the oxidation steps and formation of the support pillars after forming the metal layer.

If a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 221 USPQ 1125 (Fed. Cir. 1984). In addition, the proposed modification cannot change the principle of operation of the reference being modified. If so, the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 123 USPQ 349 (CCPA 1959). See MPEP 2143.01. Modifying MacDonald to replace the oxide support pillars **92** with a plastic material would require a change in the principles of MacDonald's structure and process and render it unsatisfactory for its intended purpose.

For at least the above stated reasons, the Examiner has failed to establish a *prima facie* case of obviousness based on MacDonald with Hofstee in further combination with McMillan,

APA or Gregory. Accordingly, the Examiner is requested to reconsider and withdraw these rejections of the claims.

No Rejection of Claims 58, 59 or 61

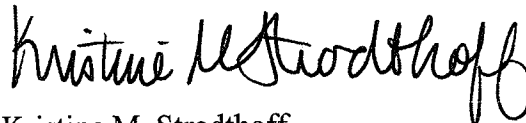
The Examiner made no rejection of Claims 58, 59 or 61. For the reasons stated above, it is submitted that these claims are likewise allowable.

Extension of Term.

The proceedings herein are for a patent application and the provisions of 37 CFR § 1.136 apply. Applicant believes that a two-month extension of term is required. Please charge the required fee (large entity) to Account No. 23-2053. If an additional extension is required, please consider this a petition therefor, and charge the required fee to Account No. 23-2053.

It is respectfully submitted that the claims are in condition for allowance and notification to that effect is earnestly solicited.

Respectfully submitted,



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